

Amendments to the Claims

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A hollow fiber membrane contactor comprising:

~~a cartridge;~~

~~a shell having two ends and an opening, and being adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and a second end;~~

~~a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;~~

~~a first tube sheet and a second tube sheet affixing said fabric to said center tube at each end of said center tube ends;~~

~~a plug located at said first tube sheet;~~

~~said fiber lumens being open at the first tube sheet and said hollow fiber lumens being closed at the second tube sheet;~~

~~said first end cap being attached exclusively to said~~

~~first end of said shell;~~

~~said first end cap and said first tube sheet defining a first head space therebetween; said first end cap having an opening therethrough, wherein said first end cap opening being in communication with hollow fiber lumens via first head space;~~

~~said second end cap being attached exclusively to said second end of said shell;~~

~~said second end cap having an opening, said second end cap opening being in communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of
said shell where said first end cap and said first tube sheet
defining a first head space therebetween;

said first end cap opening being in communication with
said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of
said shell where said second end cap and said second tube sheet
defining a second head space therebetween;

said second end cap opening being in communication with
said center tube via said second head space;

wherein fluid being introduced into said contactor via
said second end cap opening, said fluid being distributed across
said hollow fiber fabric, said fluid then exiting said contactor
via said shell opening, and a vacuum being applied via said first
cap end opening;

wherein said shell, said first end cap, said second end
cap, said center tube, said first tube sheet, said second tube
sheet, and said plug are made from a same material.

2. (canceled)

3. (previously presented) The hollow fiber membrane
contactor according to Claim 1, wherein said same material being
polyethylene.

4. (original) The hollow fiber membrane contactor according to Claim 1, wherein said shell having a diameter of 4 inches (10 cm) or less.

5. (original) The hollow fiber membrane contactor according to Claim 1, wherein said shell having a length of 24 inches (60 cm) or less.

6. (original) The hollow fiber membrane contactor according to Claim 1, said contactor further comprising a baffle.

7. (currently amended) A system for degassing a liquid comprising:

a liquid under an elevated pressure;

a hollow fiber membrane contactor comprising;

~~a cartridge;~~

~~a shell having two ends and an opening, and being adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and a second end;~~

~~a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube,~~

~~a first tube sheet and a second tube sheet affixing said fabric to said center tube at each end of said center tube ends,~~

~~a plug located at said first tube sheet,~~

~~said fiber lumens being open at the first tube sheet and said hollow fiber lumens being closed at the second tube sheet,~~

~~said first end cap being attached exclusively to said first end of said shell,~~

~~said first end cap and said first tube sheet defining a first head space therebetween, said first end cap having an opening therethrough, wherein said first end cap opening being in communication with hollow fiber lumens via first head space,~~

~~said second end cap being attached exclusively to said second end of said shell,~~

~~said second end cap having an opening, said second end cap opening being communication with said center tube,~~

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and
said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;

said first end cap opening being in communication with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said fluid under the elevated pressure being introduced to said contactor via said second end cap opening, said fluid under the elevated pressure being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening;

wherein said shell, said first end cap, said second end cap, said center tube, said first tube sheet, said second tube sheet, and said plug are made from a same material.

8. (currently amended) A hollow fiber membrane contactor comprising:

~~a cartridge;~~

~~a shell having two ends, and an opening, adapted to enclose said cartridge; and~~

~~end caps welded to each said shell end;~~

~~said cartridge comprising;~~

~~a perforated center tube having two ends;~~

~~a hollow fiber fabric surrounding said tube, said hollow fiber fabric comprising hollow fiber membranes, said hollow fiber membranes having a lumen;~~

~~a tube sheet affixing said fabric to said tube at each said tube end; and~~

~~a plug located at one end of said tube;~~

~~wherein hollow fiber lumens being open at the tube sheet next to said plug and hollow fiber lumens being closed at the other tube sheet;~~

~~one of said end caps being attached exclusively to one of said ends of said shell;~~

~~wherein said end cap and said tube sheet having open lumens defining a head space therebetween and said end cap having an opening therethrough and said opening being in communication with head space; said head space being in communication with said hollow fiber lumens at the tube sheets next to said plug;~~

~~said other end cap being attached exclusively to said other end of said shell;~~

~~wherein said other end cap having an opening therethrough and said opening being in communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having two ends;

a hollow fiber fabric surrounding said tube, said hollow fiber fabric comprising hollow fiber membranes, said hollow fiber membranes having a lumen;

tube sheets affixing said fabric to said tube at each said tube end; and

a plug located at one end of said tube;

wherein hollow fiber lumens being open at the tube sheet next to said plug and hollow fiber lumens being closed at the other tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

end caps having an opening therethrough;

said end caps being adjoined to said shell ends;

wherein one of said end caps and said tube sheet next to said plug defining a first head space therebetween where said end cap opening being in communication with said hollow fiber lumens via said headspace;

wherein said other end cap and said other tube sheet defining a second head space therebetween where said end cap opening being in communication with said center tube via said second head space;

wherein fluid introduced into said contactor via said opening in communication with said center tube being distributed across said hollow fiber fabric and exiting said contactor via said opening through said shell, and a vacuum being applied via said opening in communication with said ~~head space~~ hollow fiber lumens;

wherein said shell, said end caps, said center tube, said tube sheets, and said plug are made from a same material.

9. (canceled)

10. (previously presented) The hollow fiber membrane contactor according to Claim 8, wherein said same material being polyethylene.

11. (original) The hollow fiber membrane contactor according to Claim 8, wherein said shell having a diameter of 4 inches (10 cm) or less.

12. (original) The hollow fiber membrane contactor according to Claim 8, wherein said shell having a length of 24 inches (60 cm) or less.

13. (original) The hollow fiber membrane contactor according to Claim 8, said contactor further comprising a baffle.

14. (currently amended) A system for introducing a gas into a liquid comprising:

a liquid;

a gas under an elevated pressure;

a hollow fiber membrane contactor comprising;

~~a cartridge;~~

~~a shell having two ends and an opening, and being adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and
a second end;~~

~~a hollow fiber fabric comprising hollow fiber
membranes, each said hollow fiber membrane having a lumen, said
hollow fiber fabric surrounding said center tube;~~

~~a first tube sheet and a second tube sheet
affixing said fabric to said center tube at each end of said center
tube ends;~~

~~a plug located at said first tube sheet;~~

~~said fiber lumens being open at the first tube sheet
and said hollow fiber lumens being closed at the second tube sheet;~~

~~said first end cap being attached exclusively to
said first end of said shell;~~

~~said first end cap and said first tube sheet
defining a first head space therebetween; said first end cap having
an opening therethrough, wherein said first end cap opening being
in communication with hollow fiber lumens via first head space;~~

~~said second end cap being attached exclusively to
said second end of said shell;~~

~~said second end cap having an opening, said second
end cap opening being communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and
a second end;

a hollow fiber fabric comprising hollow fiber
membranes, each said hollow fiber membrane having a lumen, said
hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet
affixing said fabric to said center tube at each of said center
tube ends;

a plug located at said first tube sheet; and
said fiber lumens being open at said first tube
sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell
being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end
of said shell where said first end cap and said first tube sheet
defining a first head space therebetween;

said first end cap opening being in communication
with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second
end of said shell where said second end cap and said second tube
sheet defining a second head space therebetween;

said second end cap opening being in communication

with said center tube via said second head space;

wherein said gas under the elevated pressure being introduced into said hollow fiber lumens via said first end cap opening, and simultaneously said fluid being introduced to said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening;

wherein said shell, said first end cap, said second end cap, said center tube, said first tube sheet, said second tube sheet, and said plug are made from a same material.

15. (previously presented) The hollow fiber membrane contactor according to claim 1 wherein said shell opening being located at a midpoint between said two ends of said shell.

16. (previously presented) The system for degassing a liquid according to claim 7 wherein said shell opening being located at a midpoint between said two ends of said shell.

17. (previously presented) The hollow fiber membrane contactor according to claim 8 wherein said shell opening being located at a midpoint between said two ends of said shell.

18. (previously presented) The system for degassing a liquid according to claim 14 wherein said shell opening being located at a midpoint between said two ends of said shell.

19. (currently amended) A hollow fiber membrane contactor comprising:

~~a cartridge;~~

~~a shell having two ends and an opening, and being adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and a second end;~~

~~a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;~~

~~a first tube sheet and a second tube sheet affixing said fabric to said center tube at each end of said center tube ends;~~

~~a plug located at said first tube sheet;~~

~~said fiber lumens being open at the first tube sheet and said hollow fiber lumens being closed at the second tube sheet;~~

~~said first end cap being attached exclusively to said first end of said shell;~~

~~said first end cap and said first tube sheet defining a first head space therebetween; said first end cap having an opening therethrough, wherein said first end cap opening being in communication with hollow fiber lumens via first head space;~~

~~said second end cap being attached exclusively to said second end of said shell;~~

~~said second end cap having an opening, said second end cap opening being communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and a second end;

a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;

a plug located at said first tube sheet; and

said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end of

said shell where said first end cap and said first tube sheet
defining a first head space therebetween;

said first end cap opening being in communication with
said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of
said shell where said second end cap and said second tube sheet
defining a second head space therebetween;

said second end cap opening being in communication with
said center tube via said second head space;

wherein fluid being introduced into said contactor via
said second end cap opening, said fluid being distributed across
said hollow fiber fabric, said fluid then exiting said contactor
via said shell opening, and a vacuum being applied via said first
cap end opening.

20. (currently amended) A system for degassing a liquid
comprising:

a liquid under an elevated pressure;

a hollow fiber membrane contactor comprising;

~~a cartridge;~~

~~a shell having two ends and an opening, and being~~
~~adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and
a second end;~~

~~a hollow fiber fabric comprising hollow fiber
membranes, each said hollow fiber membrane having a lumen, said
hollow fiber fabric surrounding said center tube;~~

~~a first tube sheet and a second tube sheet
affixing said fabric to said center tube at each end of said center
tube ends;~~

~~a plug located at said first tube sheet;~~

~~said fiber lumens being open at the first tube sheet
and said hollow fiber lumens being closed at the second tube sheet;~~

~~said first end cap being attached exclusively to
said first end of said shell;~~

~~said first end cap and said first tube sheet
defining a first head space therebetween; said first end cap having
an opening therethrough, wherein said first end cap opening being
in communication with hollow fiber lumens via first head space;~~

~~said second end cap being attached exclusively to
said second end of said shell;~~

~~said second end cap having an opening, said second
end cap opening being communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having a first end and
a second end;

a hollow fiber fabric comprising hollow fiber
membranes, each said hollow fiber membrane having a lumen, said
hollow fiber fabric surrounding said center tube;

a first tube sheet and a second tube sheet
affixing said fabric to said center tube at each of said center
tube ends;

a plug located at said first tube sheet; and
said fiber lumens being open at said first tube
sheet and said fiber lumens being closed at said second tube sheet;

a shell having two ends and an opening, said shell
being adapted to enclose said cartridge;

said tube sheets being sealed to said shell;

a first end cap having an opening therethrough;

said first end cap being adjoined to said first end
of said shell where said first end cap and said first tube sheet
defining a first head space therebetween;

said first end cap opening being in communication
with said hollow fiber lumens via said first head space;

a second end cap having an opening therethrough;

said second end cap being adjoined to said second
end of said shell where said second end cap and said second tube
sheet defining a second head space therebetween;

said second end cap opening being in communication
with said center tube via said second head space;

wherein said fluid under the elevated pressure being introduced to said contactor via said second end cap opening, said fluid under the elevated pressure being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening.

21. (currently amended) A hollow fiber membrane contactor comprising:

~~a cartridge;~~

~~a shell having two ends, and an opening, adapted to~~
~~enclose said cartridge; and~~

~~end caps welded to each said shell end;~~

~~said cartridge comprising;~~

~~a perforated center tube having two ends;~~

~~a hollow fiber fabric surrounding said tube, said~~
~~hollow fiber fabric comprising hollow fiber membranes, said hollow~~
~~fiber membranes having a lumen;~~

~~a tube sheet affixing said fabric to said tube at~~
~~each said tube end; and~~

~~a plug located at one end of said tube;~~

~~wherein hollow fiber lumens being open at the tube sheet~~
~~next to said plug and hollow fiber lumens being closed at the other~~
~~tube sheet;~~

~~one of said end caps being attached exclusively to one of
said ends of said shell;~~

~~wherein said end cap and said tube sheet having open
lumens defining a head space therebetween and said end cap having
an opening therethrough and said opening being in communication
with head space; said head space being in communication with said
hollow fiber lumens at the tube sheets next to said plug;~~

~~said other end cap being attached exclusively to said
other end of said shell;~~

~~wherein said other end cap having an opening therethrough
and said opening being in communication with said center tube;~~

a cartridge;

said cartridge comprising:

a perforated center tube having two ends;

a hollow fiber fabric surrounding said tube, said
hollow fiber fabric comprising hollow fiber membranes, said hollow
fiber membranes having a lumen;

tube sheets affixing said fabric to said tube at
each said tube end; and

a plug located at one end of said tube;

wherein hollow fiber lumens being open at the tube
sheet next to said plug and hollow fiber lumens being closed at the
other tube sheet;

a shell having two ends and an opening, said shell being
adapted to enclose said cartridge;

said tube sheets being sealed to said shell;
end caps having an opening therethrough;
said end caps being adjoined to said shell ends;
wherein one of said end caps and said tube sheet next to
said plug defining a first head space therebetween where said end
cap opening being in communication with said hollow fiber lumens
via said headspace;

wherein said other end cap and said other tube sheet
defining a second head space therebetween where said end cap
opening being in communication with said center tube via said
second head space;

wherein fluid introduced into said contactor via said
opening in communication with said center tube being distributed
across said hollow fiber fabric and exiting said contactor via said
opening through said shell, and a vacuum being applied via said
opening in communication with said ~~head-space~~ hollow fiber lumens.

22. (currently amended) A system for introducing a gas into a
liquid comprising:

a liquid;

a gas under an elevated pressure;

a hollow fiber membrane contactor comprising;

~~a cartridge;~~

~~a shell having two ends and an opening, and being adapted for enclosing said cartridge;~~

~~a first end cap; and~~

~~a second end cap;~~

~~said cartridge further comprising;~~

~~a perforated center tube having a first end and a second end;~~

~~a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;~~

~~a first tube sheet and a second tube sheet affixing said fabric to said center tube at each end of said center tube ends;~~

~~a plug located at said first tube sheet;~~

~~said fiber lumens being open at the first tube sheet and said hollow fiber lumens being closed at the second tube sheet;~~

~~said first end cap being attached exclusively to said first end of said shell;~~

~~said first end cap and said first tube sheet defining a first head space therebetween; said first end cap having an opening therethrough, wherein said first end cap opening being in communication with hollow fiber lumens via first head space;~~

~~said second end cap being attached exclusively to said second end of said shell;~~

~~said second end cap having an opening, said second end cap opening being communication with said center tube,~~
a cartridge;
said cartridge comprising:
a perforated center tube having a first end and
a second end;
a hollow fiber fabric comprising hollow fiber membranes, each said hollow fiber membrane having a lumen, said hollow fiber fabric surrounding said center tube;
a first tube sheet and a second tube sheet affixing said fabric to said center tube at each of said center tube ends;
a plug located at said first tube sheet; and
said fiber lumens being open at said first tube sheet and said fiber lumens being closed at said second tube sheet;
a shell having two ends and an opening, said shell being adapted to enclose said cartridge;
said tube sheets being sealed to said shell;
a first end cap having an opening therethrough;
said first end cap being adjoined to said first end of said shell where said first end cap and said first tube sheet defining a first head space therebetween;
said first end cap opening being in communication with said hollow fiber lumens via said first head space;
a second end cap having an opening therethrough;

said second end cap being adjoined to said second end of said shell where said second end cap and said second tube sheet defining a second head space therebetween;

said second end cap opening being in communication with said center tube via said second head space;

wherein said gas under the elevated pressure being introduced into said hollow fiber lumens via said first end cap opening, and simultaneously said fluid being introduced to said contactor via said second end cap opening, said fluid being distributed across said hollow fiber fabric, said fluid then exiting said contactor via said shell opening.